WICOR International Technical Report

REPORT #	3206	REV.	0
DATE WRITTEN:	2/3/06		
SUBJECT / TITLE:	Oil Impregnation Rate of Cooper FR3 Oil		
KEYWORDS:	FR3 Vegetable Oil Impregnation		

SUMMARY:

[Purpose]

To determine the time to impregnate laminated pressboard with Cooper FR3 Oil. FR3 has a higher viscosity than mineral oil. The higher viscosity affects the impregnation rate.

[Procedure]

Blocks of TX2, laminated pressboard, were fabricated to a dimension of 8 inch x 8 inch x 1 inch thick. Each block had a 0.5" diameter hole drilled in the center of the block. The edges of the block were coated with polyester resin to prevent oil penetration from the edge.

All blocks were dried in a circulating hot air oven at 105 C for 48 hours followed by vacuum drying at 105 C for 48 hours. The blocks were then placed in a hot air oven at 105 C until needed for testing.

The rate of oil impregnation was tested at 60 C, 80 C, and 100 C. For each temperature, six blocks were taken from the hot air oven (set at 105 C) and placed in a vacuum oven set to the temperature at which the impregnation rate was to be determined, 60, 80 or 100 C. The blocks were left in the vacuum oven for at least 24 hours or a vacuum reading of less than 300 microns Hg was achieved. In the meantime FR3 oil was heated to the corresponding test temperature.

The FR3 oil was introduced into the vacuum oven until the TX2 blocks were covered with fluid. A vacuum level of less than 500 Microns Hg was maintained during this vacuum impregnation period. The blocks were then left in the FR3 fluid for various periods of time.

After specific time intervals a block was removed from the fluid and split in half. The rate of oil impregnation was measured visually by the darkened pressboard. Samples were removed from the oil and the impregnation distance measured until the block was completely impregnated to the edge.

[Background]

Cooper FR3 fluid is an alternative to mineral oil for distribution and power transformers. Due to the higher viscosity of FR3 in comparison to mineral oil the rate of oil impregnation was postulated to be slower than mineral oil.

[Observations]

Observations can be seen in the attached graph on page 2.

[Conclusions]

FR3 fluid takes longer to impregnate than mineral oil. In project #1866 (December, 1993) the rate of impregnation of mineral oil was determined at 20 C, 45 C, and 90 C. A good way to compare relative impregnation times is to compare the time that it takes to impregnate a distance of 3 inches. EHV Weidmann recommends that oil impregnation and dryout holes be placed in laminated pressboard on 4 inch centers. If one assumes a 3 inch distance for impregnation then a plate of laminated pressboard would be completely impregnated in this time.

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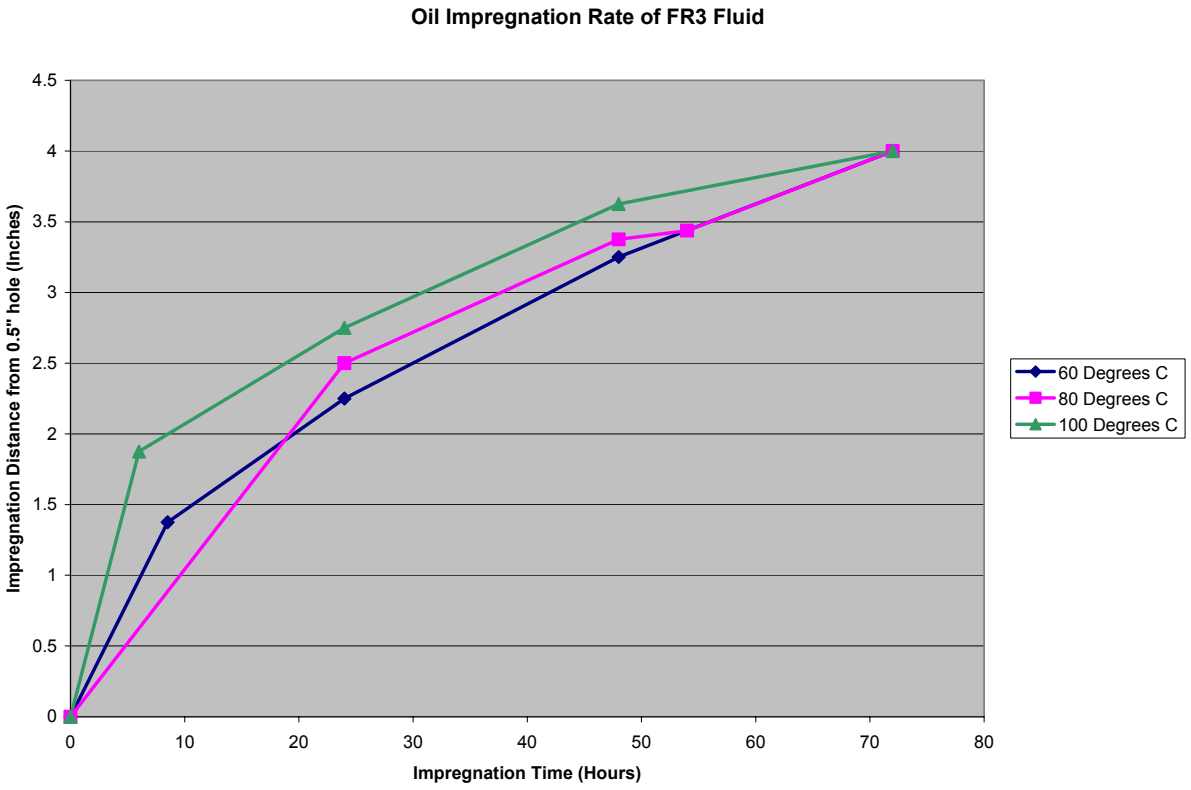
A summary of the time to impregnate:
Fluid: FR3

Temperature	Time to Impregnate 3 Inches
60 C	42 Hours
80 C	37 Hours
100 C	30 Hours

From project 1866:
Fluid: Mineral Oil

Temperature	Time to Impregnate 3 Inches
20 C	120 Hours
45 C	25 Hours
90 C	18 Hours



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